

REMARKS

Claims 20-50 are pending. By this Amendment, no claims are cancelled, claims 20, 23-26, 39, 41, 42 and 48 are amended and no new claims are added.

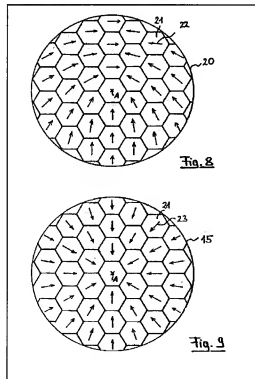
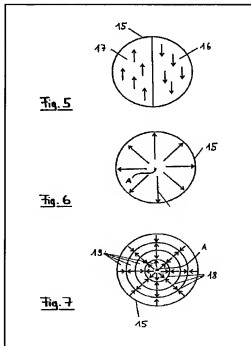
Interview Summary

Applicant thanks Examiner Nguyen and Primary Examiner Van for their time and courtesy during the telephone interview of October 18, 2010. During the interview, claims 20 and 39 and various dependent claims were discussed. The Examiner explained his interpretation of the prior art reference to An, particularly with reference to paragraph 30 of An. No agreement was reached. Applicant notes that the Examiner's interview summary indicates that claim 1 was discussed. Since claim 1 was cancelled in a Preliminary Amendment filed September 20, 2006 Applicant assumes that this is a typographical error and that the Examiner intended to refer to independent claim 20.

35 U.S.C. § 102

The Office Action rejected claims 20, 22, 24-26, 39 and 41-42 under 35 U.S.C. § 102(a) as being anticipated by An et al. (U.S. Publication 2004/0124184). Applicant respectfully traverses the rejection. According to the Office Action and the telephone interview, the Examiner indicates that the limitations "a polarization modulator which causes the focused machining laser radiation to be linearly polarized, with a polarization direction varying across the beam cross-section" are disclosed by the An reference in paragraph 0030 by the sentence that states "The laser beam polarizer 12 is rotatable for adjusting the direction of the polarization."

"During patent examination, the pending claims must be "given their broadest reasonable interpretation *consistent with the specification*." Phillips v. AWH Corp., 415 F.3d 1303, 75 USPQ2d 1321 (Fed. Cir. 2005), See MPEP 2111. Emphasis added. Applicant respectfully submits that this disclosure of An indicates only a standard rotatable beam polarizer and that the beam polarizer rotates a polarizing member in such a way that the beam polarization is constant across the entire width of the laser beam and the entire width of the laser beam is thereby subject to rotatable polarization. According to the An disclosure there is no variation in polarization across the beam as recited in claim 20 when claim 20 is read in light of the specification. The Application describes this aspect of the invention, for example, in paragraphs 0057 through 0069 of the application as published. Example embodiments of the invention are depicted, for example, in Figs. 5-9 reproduced below.



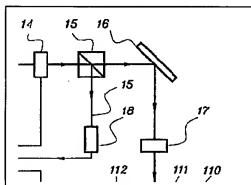
When read consistent with the specification, the limitations recited in claim 20 are not disclosed or suggested by An and claim 20 should be patentable for at least this reason. Independent claim 39 should be patentable for similar reasons.

However, to advance prosecution, Applicant has amended claim 20 to recite the limitations “at least two regions within the cross section, including a first region and a second region” and “a polarization modulator which causes the focused machining laser radiation to be linearly polarized, with a polarization direction being different in the first region as compared to the second region.” These limitations are clearly not disclosed or suggested by the An reference or the other prior art that has been cited in the application. Accordingly, claim 20 should be patentable for at least these reasons.

Similarly, independent claim 39 has been amended to recite the limitations “varying a polarization direction in first region of a beam cross section as compared to a second region of the beam cross-section such that the polarization direction is different in the first region as compared to the second region.” As discussed above, these limitations are not disclosed or suggested by the An reference. Claims 21-38 depend from claim 20 and should be patentable for at least the same reason as claim 20. Claims 40-50 depend from claim 39 and should be patentable for at least the same reasons as claim 39. Applicant respectfully requests that the Examiner withdraw the rejection.

Dependent ClaimsClaim 22

The Office Action indicates that An et al., further discloses the polarization modulator 12 (Fig. 1) arranged between the laser radiation source 11 (Fig. 1) and the deflecting unit (16, Fig. 1). Applicant respectfully traverses the rejection. Claim 22 depends from claim 21 which further depends from claim 20. Accordingly, all of the limitations of claim 21 are incorporated in claim 22. Claim 21 recites the limitations “a deflecting unit which modifies a spatial position of the focus in the material by controllable deflection of the laser beam, the deflection being controlled such that the focused machining laser radiation is shifted three dimensionally.” The Office Action does not even indicate that these limitations are present in the An reference.

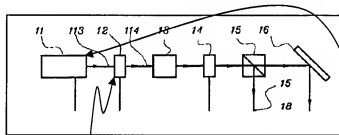


The Office Action alleges that Reference Numeral 16 indicates a deflecting unit as recited in claim 21. This is incorrect. Reference Numeral 16 as disclosed by An identifies reflecting mirror 16 (see paragraph 30, Fig. 1). The reflecting mirror 16 as disclosed by An is fixed and therefore cannot be “a deflecting unit which modifies a spatial position of the focus of the material by controllable deflection of the laser beam” as recited in claim 21. This limitation is incorporated in claim 22 by its dependency on claim 21. Accordingly, all of the limitations of

claim 22 are not disclosed or suggested by the An reference and An cannot anticipate claim 22. Claim 22 should be patentable for at least this additional reason. Applicant respectfully requests that the Examiner withdraw the rejection.

Claim 24

The Office Action indicates “regarding claim 24, An et al., further discloses the polarization modulator 12 (Fig. 1) is arranged within the laser radiation source 11 (Fig. 1).”



Applicant respectfully traverses the rejection. As can be seen in Fig. 1 in An, partially reproduced above, polarization modulator 12 is a separate device from laser radiation source 11 and is depicted to be outside rather than within laser radiation source 11. Accordingly, the An reference does not disclose that the polarization modulator 12 “is arranged within the laser radiation source” as recited in claim 24. Accordingly, these limitations of claim 24 are not disclosed or suggested by An and An cannot anticipate claim 24. Claim 24 should be patentable for at least this additional reason. Applicant respectfully requests that the Examiner withdraw the rejection.

Claim 25

The Office Action further states that An discloses that the polarization modulator 12 (Fig. 1) is adjustable with respect to the variation of the polarization direction (paragraph 30). Applicant respectfully traverses the rejection.

Paragraph 0030 recites:

[0030] As shown in FIG. 1, a system for forming periodic structures on a substrate according to one embodiment of the present invention comprises a laser source 11, a laser beam polarizer 12, a beam expander 13, a beam attenuator 14, a sampler 15, a reflecting mirror 16, a laser power detector 18, a focusing unit 17, a computer 19, an X-Y stage 110 and an air nozzle 112. The laser beam polarizer 12 is rotatable for adjusting the direction of the polarization. Mounted on and carried by the X-Y stage 110 is a substrate 111 on which the periodic structure is to be formed.

As discussed above, because An does not disclose variation of the polarization direction across the cross section of the laser beam and only discloses conventional rotation of a polarizer, it cannot disclose the polarization modulator is adjustable.

Further applicant has amended claim 25 to recite “wherein the polarization modulator is adjustable with respect to the variation of the polarization direction in the first region as compared to the second region.” These limitations are not disclosed or suggested by the An reference and claim 25 should be patentable for at least this additional reason. Applicant respectfully requests that the Examiner withdraw the rejection.

Claim 26

The Office Action states “regarding claim 26 An et al., further discloses a control unit 19 (Fig. 1) which modifies the variation of the polarization direction during operation of the machine device (paragraph 31).” Applicant respectfully traverses the rejection. The sentence of paragraph 31 that the Office Action relies on, states “[t]he operation of the laser source 11, movement of the X-Y stage 110, adjustment of the polarizer 12 and the attenuator 14 may be centrally controlled by the computer 19.” This sentence does not disclose or suggest that the variation of polarization direction is adjusted during operation of the machining device as recited in claim 26. This sentence merely states that adjustments are centrally controlled by the computer 19. According, these limitations are not disclosed or suggested by the An reference, and claim 26 should be patentable for at least this additional reason. Applicant respectfully requests that the Examiner withdraw the rejection.

Dependent Claim 41

Dependent claim 41 depends from independent method claim 39. The Office Action asserts “regarding claim 41 An et al., further discloses adjusting the variation of the polarization direction during machining (paragraph 32, 36). Paragraph 32 of An recites:

[0032] When directed and focused onto the substrate 111, the polarized laser beam 114 will induce a surface wave thereon. Details of the formation of the surface wave will be discussed below. For ease of illustration, stripes 224, 225 and 226 represent the wave peaks of the induced surface wave under the coverage of a laser spot 214 as shown in FIG. 2. It should be appreciated that subject to the

wavelength and the focusing adjustment of the laser beam, the size of the spot 214 may vary and it may cover either lesser or greater numbers of wave peaks.

Paragraph 36 of An recites:

[0036] The substrate 111 is now moved by the X-Y stage 110 relative to the laser beam 114, which cause the laser beam 114 scanning on the substrate 111 along a first path 402a (FIG. 4A) substantially perpendicular ("perpendicular polarization") to the polarization direction of the laser beam 114. Subsequent locations on the substrate surface following the movement are melted by absorbing the laser energy, and the surface wave is continuously induced and carried by the laser beam 114 along the first path 402a. In this regard, the surface wave is propagated following the movement, which generates new ridges 304a (FIG. 3B) and 305a (FIG. 3C). The newly formed ridges during the process are referred to in this context as "leading ridges" with respect to their position relative to the laser beam.

As can be seen above, neither of these paragraphs discloses or suggests "adjusting the variation of the polarization direction during machining" as recited in claim 41. Thus, An does not disclose all of the limitations of claim 41 and cannot anticipate claim 41. Accordingly, claim 41 should be patentable for at least this additional reason.

Further, Applicant has amended claim 41 to recite "adjusting the variation of the polarization direction in the first region of the beam cross section as compared to the second region of the beam cross section during machining." These limitations are not disclosed or suggested by the An reference because the An reference does not disclose variation of the

polarization direction in the first region of the beam cross section as compared to the second region of the beam cross section. Accordingly, amended claim 41 should be patentable for at least this additional reason. Applicant respectfully requests that the Examiner withdraw the rejection.

Claim 42

The Office Action states “regarding claim 42, An et al., further discloses determining and controlling a quality parameter of machining with the variation of the polarization direction being used as the manipulated variable (paragraph 31-32). Paragraph 0031 recites:

[0031] A laser beam 113 generated from the laser source 11 is directed into the polarizer 12 to form a linearly polarized laser beam 114, which is subsequently directed through the attenuator 14, the sampler 15, the mirror 16, the focusing unit 17 onto the substrate 111. The substrate 111 is made of optical material such as glass, which is transparent to visible light and absorbs the laser used. The sampler 15 takes a sampling beam 115 into the power detector 18 for measuring and monitoring the laser power level together with the computer 19. A compressed air flow is directed through the air nozzle 112 onto the substrate 111 for cooling the substrate 111. The operation of the laser source 11, movement of the X-Y stage 110, adjustment of the polarizer 12 and the attenuator 14 may be centrally controlled by the computer 19.

Paragraph 0032 recites:

[0032] When directed and focused onto the substrate 111, the polarized laser beam 114 will induce a surface wave thereon. Details of the formation of the surface wave will be discussed below. For ease of illustration, stripes 224, 225 and 226 represent the wave peaks of the induced surface wave under the coverage of a laser spot 214 as shown in FIG. 2. It should be appreciated that subject to the wavelength and the focusing adjustment of the laser beam, the size of the spot 214 may vary and it may cover either lesser or greater numbers of wave peaks.

Nothing in these passages of An discloses or suggests determining and controlling a quality parameter of machining with the variation of polarization direction being used as the manipulated variable as recited in claim 42.

Further, Applicant has amended claim 42 to recite:

determining and controlling a quality parameter of machining by manipulating a manipulated variable, with the variation of the polarization directions in the first region of the beam cross section as compared to the second region of the beam cross section being used as the manipulated variable.

These limitations are not disclosed or suggested by An. Accordingly, An cannot anticipate claim 42 for this additional reason and claim 42 should be patentable. Applicant respectfully requests that the Examiner withdraw the rejection.

35 U.S.C. § 103

Claim 23

The Office Action rejected claim 23 under 35 U.S.C. § 103(a) as being unpatentable over An in view of Wang et al. (U.S. Publication 2004/0196469) or Campin et al. (U.S. Publication 2003/0078753). According to the Office Action, “An et al., discloses the polarization modulator 12 (Fig. 1) inhomogeneously modifies the polarization direction of the laser beam across the beam cross section **except** the laser radiation source emits linearly polarized radiation.” As has been discussed above An does not disclose or suggest this limitation. Further, claim 23 depends from claim 20 and should be patentable for at least the same reasons as claim 20.

Claims 27-30

The Office Action rejected claim 27-30 under 35 U.S.C. § 103(a) as being unpatentable over An in view of Ngoi et al. (U.S. Patent 6,555,781). Claims 27-30 should be patentable at least by virtue of dependency on a patentable base claim.

The Office Action states that one of ordinary skill would make these modifications to the An reference “for the purpose of having ultra short pulse laser machine.” Applicant respectfully traverses the rejection because this statement is not a reason that one would make any modification at all, but merely a statement of what the machine is. Accordingly, this rejection does not make out a prima facie case of obviousness because the Office Action does not articulate a reason as to why one of ordinary skill in the art would make such a modification to the An reference. Applicant respectfully requests that the Examiner withdraw the rejection.

Claims 21, 40 and 44

The Office Action rejected claims 21, 40 and 44 as being unpatentable over An in view of Swinger et al. (U.S. Patent 6,325,792). The Office Action states “regarding claim 21, An et al. discloses a deflecting unit 16 (Fig. 1), which modifies a spatial position of the focus of material by controllable deflection in laser beam, except that the deflection being controlled such that the focus machining of laser radiation is shifted three dimensionally. Applicant respectfully traverses the assertion and the rejection. As discussed above, the An reference does not disclose a deflecting unit by disclosing mirror 16. Reference Numeral 16 refers to a fixed mirror which is not a deflecting unit as defined in claim 21.

Further, the Office Action indicates that one would modify the An reference as taught by Swinger et al., “for the purpose of verifying the two or more dimensional scan position of the laser beam.” Again, this does not state a reason why one of ordinary skill in the art would modify the An reference but merely reiterates what the limitations that are recited in claim 21. Further the Office Action does not make any explanation of how the proposed modification would lead to “verifying the two or more dimensional scan position of the laser beam.” The Office Action makes the same statement with regard to claims 40 and 44. These rejections are traversed for the same reasons.

Claim 43

The Office Action rejected claim 43 under 35 U.S.C. § 103(a) as being unpatentable over An et al., in view of Haight et al. (U.S. Publication 2002/0125230). The Office Action indicates regarding claim 42, An et al., discloses focusing laser radiation in the vicinity of the surface of the material 15 (Fig. 1) to be machined, except that the distance of the focus from the surface of

the material to be machined lying approximately in the range of the Rayleigh length of the radiation. According to the Office Action, Haight et al., discloses this limitation at paragraphs 10 and 55. Paragraph 10 of Haight recites

[0010] In one aspect, the method of the invention provides a laser beam which defines a spot that has a lateral gaussian profile characterized in that fluence at or near the center of the beam spot is greater than the threshold fluence whereby the laser induced breakdown is ablation of an area within the spot. The maximum intensity is at the very center of the beam waist. The beam waist is the point in the beam where wave-front becomes a perfect plane; that is, its radius of curvature is infinite. This center is at radius $R=0$ in the x-y axis and along the Z axis, $Z=0$. This makes it possible to damage material in a very small volume $Z=0$, $R=0$. Thus it is possible to make features smaller than spot size in the x-y focal plane and smaller than the Rayleigh range (depth of focus) in the Z axis. It is preferred that the pulse width duration be in the femtosecond range although pulse duration of higher value may be used so long as the value is less than the pulse width defined by an abrupt or discernable change in slope of fluence breakdown threshold versus laser beam pulse width.

Paragraph 55 of Haight recites:

[0055] A series of tests were performed on an SiO_2 (glass) sample to determine the laser induced breakdown (LIB) threshold as a function of pulse width between 150 fs-7 ns, using a CPA laser system. The short pulse laser used was a 10 Hz Ti:Sapphire oscillator amplifier system based on the CPA technique. The laser

pulse was focused by an $f=25$ cm lens inside the SiO₂ sample. The Rayleigh length of the beam is .about.2 mm. The focused spot size was measured in-situ by a microscope objective lens. The measured spot size FWHM (full at half max) was 26 .mu.m in diameter in a gaussian mode. The fused silica samples were made from Corning 7940, with a thickness of 0.15 mm. They were optically polished on both sides with a scratch/dig of 20-10. Each sample was cleaned by methanol before the. Thin samples were used in order to avoid the complications of self-focusing of the laser pulses in the bulk. The SiO₂ sample mounted on a computer controlled motorized X-Y translation stage. Each location on the sample was illuminated by the laser only once.

As can be seen, while these paragraphs discuss the Rayleigh length, there is no disclosure or suggestion in these passages that the laser radiation is focused in the vicinity of the surface of the material at a "distance of the focus from the surface of the material to be machined lying approximately in the range of the Rayleigh length of the radiation." Accordingly, this limitation is not disclosed or suggested by the An reference and claim 43 should be patentable for at least this additional reason. Applicant respectfully requests that the Examiner withdraw the rejection.

Withdrawn Claims

Claims 31-38 and 45-50 stand withdrawn from consideration. Each of the withdrawn claims is dependent from a patentable base claim and should be patentable for at least the same reasons as its base claim. Applicant respectfully requests that the withdrawn claims be rejoined and allowed.

Application No. 10/593,501

In view of the foregoing, it is submitted that this application is in condition for allowance. Favorable consideration and prompt allowance of the application are respectfully requested.

The Examiner is invited to telephone the undersigned if the Examiner believes it would be useful to advance prosecution.

Respectfully submitted,

A handwritten signature in dark ink, appearing to read 'P. C. Onderick', followed by a horizontal line.

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